4. (Twice Amended) The multilayered air-fuel ratio sensor according to claim 1, wherein said ~~first and second~~ [heterogeneous] boundary layer comprises ~~boundary layers comprise~~ a component selected from the group consisting of alumina, spinel and steatite.

Please add the following new claim.

-- 6. The multilayered air-fuel ratio sensor according to claim 1, wherein said boundary layer has ~~first and second boundary layers have~~ a thickness in a range of 10 to 100 μm. --

REMARKS

Reconsideration of the outstanding rejections in view of the above amendments and following remarks is respectfully requested.

Claims 1-2, 4 and 6 are pending. Claims 1-2 and 4 have been amended. Claim 3 has been cancelled and claim 6 has been added. Claim 1 has been amended to incorporate the language of cancelled claim 3. Claims 2 and 4 have been amended to better define the present invention. Support for the insertion of "directly" is found in Figure 10, in that boundary layer 10 is directly interposed between two adjacent solid electrolyte substrate layers 31 and 32. Another boundary layer 10 (*i.e.*, the second boundary layer defined in claim 1, twice amended) is directly interposed between the solid substrate layer 32 and a insulating layer 43. New claim 6 incorporates the language cancelled in the amendment to claim 1.

The above amendments are made in order to address the rejections under 35 USC § 112, and not for the purpose of obviating rejections over prior art under 35 USC §§ 102 or 103. Therefore, these amendments do not introduce new issues.

Further, no new matter has been introduced by the above amendments. Approval and entry thereof is respectfully requested.

Claim 1 defines a multilayered air-fuel sensor having a plurality of stacked layers. The multilayered air-fuel sensor comprise a plurality of multilayered substrate layers comprising at least two solid electrolytic substrate layers and at least one insulating substrate layer. The multilayered air-fuel sensor also comprises a plurality of boundary layers located at respective boundaries of said multilayered substrate layers. The plurality of boundary layers further comprise at least one first boundary layer directly interposed between two adjacent solid electrolytic substrate layers as well as at least one second boundary layer directly interposed between one of said solid electrolytic substrate layer. In this configuration, the first and second boundary layers have a sintered particle size larger than those of the substrate layers.

The benefit of the invention as defined in claim 1 is that the boundary layers having larger sintered particles sizes allows the boundary layers to function as buffers for absorbing thermal and mechanical stress. Growth of small cracks can therefore be prevented because the sensor can flex when subjected to such stress. The strength of the claimed multilayered air-fuel sensor is therefore enhanced.

Rejections Under 35 USC § 112, 1st Paragraph

The Examiner rejects claims 1-4 as allegedly containing language not supported by the specification. The Examiner asserts that the language, "*each boundary layer being made of a heterogeneous material different from that of said substrate layers*" is allegedly not supported in the specification as originally filed.

Applicants submit that in view of the cancellation of this language from claim 1, this rejection has been obviated and withdrawal thereof is requested.

Rejections Under 35 USC § 112, 2nd Paragraph

Claims 1-4 stand rejected under 35 USC § 112, 2nd paragraph as allegedly being indefinite. The Examiner alleges that applicants' use of the term "*heterogeneous*" and the phrase "*each boundary layer being made of a heterogeneous material different from that of said substrate layers*" allegedly indefinite. Applicants submit that in view of their cancellation of this language from the claims, this rejection has obviated and withdrawal of thereof is requested.

The Examiner asserts that applicants' use of the term "*adjacent*" is allegedly indefinite. Applicants submit, however, that the meaning of this term, as used in the in the context of the claim as amended, is sufficiently clear to one of ordinary skill in the art. Thus, in view of the above amendments, the Examiner's rejection has been obviated. Withdrawal of this rejection is respectfully requested.

Rejections Under 35 USC § 102(b) – Mase '274

Claims 1, 2 and 4 stand rejected under 35 USC § 102(b) as allegedly being anticipated by Mase '274 for reasons of record.

Applicants assert that by incorporating the language of claim 3 into claim 1, this rejection has been obviated because Mase '274 fails to teach that the first and second boundary layers have a sintered particle size larger than those of the substrate layers. Thus, contrary to the Examiner's assertion, Mase '274 does not disclose all elements of the claimed invention. The claims, therefore, are not anticipated and withdrawal of this rejection is respectfully requested.

Rejections Under 35 USC § 103(a)

Mase '274 or Mase '126

Claims 1-2 and 4 stand rejected under 35 USC § 103(a) as allegedly being obvious over Mase '274 or Mase '126, for reasons of record. This rejection is respectfully traversed.

As discussed above, the multilayered air-fuel ratio sensor defined by claim 1 comprises:

(i) a plurality of **multilayered substrate layers** having at least two solid electrolytic substrate layers and at least one insulating substrate layer;

(ii) a plurality of boundary layers located at respective boundaries of said multilayered substrate layers; wherein the plurality of boundary layers have:

- at least **one first boundary layer** directly interposed between **two adjacent solid electrolytic substrate layers**; in addition to
- at least **one second boundary layer** directly interposed between one of said **solid electrolyte substrate layer** and said **at least one insulating layer**;

(iii) said first and second boundary layers have a sintered particle size larger than those of said electrolytic substrate layers.

Mase '274 does not teach the configuration defined by applicants' claim 1. Specifically, Mase '274 is silent with respect to any teaching or suggestion of the presence of any boundary layers within the structure of the disclosed sensor. Thus, there is no teaching or suggestion of a first boundary layer located between two

adjacent solid electrolytic layers and a second boundary layer located between a solid electrolytic layer and an insulating substrate layer.

Mase '126 also fails to teach or suggest a plurality of boundary layers, wherein a first boundary layer is located between two adjacent solid electrolytic layers and a second boundary layer is located between a solid electrolytic layer and an insulating substrate layer.

The Examiner, however, maintains that even in the absence of any teaching or suggestion of incorporating applicants' claimed boundary layers into the disclosed structures of either Mase '274 or Mase '126, it still would have been obvious to incorporate such boundary layers because, "the relief of thermal stress would be applicable and desirable between any and all adjacent substrate layers." See Final Office Action, page 4, lines 13-15. Applicants respectfully traverse this assertion, as it is not supported by the either of Mase '274 or Mase '126. Neither of the cited Mase references teach or suggests the desirability of incorporating applicants' claimed boundary layers into the structure of either Mase reference. Further, neither reference teaches nor suggests the desirability of incorporating such boundary layers at applicants' specifically claimed locations within the structure of the sensors disclosed by Mase.

Applicants submit that in the absence of any teaching or suggestion by either of Mase '274 or Mase '126 to incorporate boundary layers into the locations specifically defined in applicants claim 1, one of ordinary skill in the art, only having the teachings of either Mase reference, would not have been motivated to make the modification asserted by the Examiner. Without the requisite motivation, one of ordinary skill in the art would not have modified Mase '274 or Mase '126 in a manner that would have rendered obvious the invention as defined by applicants' claim 1.

The Examiner has failed to establish a *prima facie* case of obviousness and withdrawal of this rejection is respectfully requested.

Mase '274 or Mase '126, in view of Suzuki

Claim 3 stands rejected under 35 USC § 103(a) as allegedly being obvious over Mase '274 or Mase '126, combined with Suzuki. Applicants respectfully traverse this rejection.

Claim 3 has been cancelled and the language of claim 3 has been incorporated into claim 1, as discussed above. Applicants assert that each primary reference (*i.e.*, Mase '274 and Mase '126) fails to teach or suggest:

(i) a plurality of boundary layers, as defined in applicants' claim 1, and

(ii) the desirability of incorporating the plurality of boundary layers at the locations specifically claimed by applicants,

for reasons discussed above. Thus, in the absence of any teaching or suggestion of incorporating a plurality of boundary layers into the sensor configurations of Mase '274 or Mase '126, there is also no teaching or suggestion of applicants' first and second boundary layers having a sintered particle size larger than that of the solid electrolytic substrate layers, as claimed by applicants in claim 1.

The Examiner cites Suzuki as allegedly teaching that it is known to use larger particles to obtain a larger porosity (see Final Office Action, page 5, line 9). The Examiner then concludes that it would have been obvious to one of ordinary skill in the art to incorporate a boundary layer having a larger grain size than the solid electrolytic substrate layer into the sensors disclosed by both cited Mase references. Suzuki, however, fails to satisfy the deficiencies of both Mase '274 and Mase '126,

with respect to any teaching or suggestion of the presence of any boundary layer in the sensor structure, as claimed by applicants in claim 1.

Suzuki teaches a gas sensor, according to Figure 1, having a single solid electrolytic substrate layer (1), surrounded by a first electrode (3) and a second electrode (2), wherein the second electrode is coated with a first porous coating (4) and a second porous coating (4'). The first porous coating (4) is made of Al_2O_3 having a fine particle grain size and the second porous coating, also made of Al_2O_3, has a larger grain size. See Figure 2. The porous coating layers (4 and 4'), however, do not function as boundary layers directly interposed between two adjacent solid electrolytic substrate layers and directly interposed between a solid electrolytic substrate layer and an insulating substrate layer, as claimed by applicant.

The Examiner acknowledges that both Mase '274 and Mase '126 lack any teaching of a plurality of boundary layers, as claimed by applicants. See Final Office Action, page 4, lines 9-12. However, in citing Suzuki, the Examiner incorrectly identifies reference number (10) of Figure 1 of Mase '274, and reference number (12) of Figure 1 of Mase '126, as porous *boundary layers*. Contrary to the Examiner's assertion, however, Mase '274 defines reference number (10) as an *electrically insulating ceramic layer*. See Mase '274, column 6, lines 17-18. Mase '126 defines reference number (12) as *a high-electric resistance ceramic layer*. See column 2, lines 61-62. Thus, contrary to the Examiner's assertions, structures (10) and (12) of Mase, are not the boundary layers claimed by applicants.

Even assuming for the sake of argument that Suzuki did teach boundary layers as claimed by applicants, which applicants assert is not the case, Suzuki fails to satisfy the configuration deficiencies of both Mase references, discussed above.

There is also no teaching or suggestion of where one of ordinary skill in the art would place such boundary layers within the structure of either Mase reference.

As such, Suzuki fails to provide any motivation to incorporate boundary layers into the sensor configurations of either Mase reference, and therefore, is also silent with respect to the sintered particle size of such boundary layers, as claimed by applicants. In view of the failure of Suzuki to provide motivation to make the modification asserted by the Examiner, the cited references are not combinable in a manner that renders the present claim obvious. The Examiner has not established a *prima facie* case of obviousness, and withdrawal of this rejection is requested.

CONCLUSION

Having fully responded to all outstanding rejections, applicants assert that all claims are in condition for allowance. Favorable notification to that effect and issuance of a Notice of Allowance is earnestly solicited.

The Examiner is invited to contact the undersigned to resolve any remaining issues, in order to advance the prosecution of this application toward allowance.

Respectfully submitted,

PILLSBURY MADISON & SUTRO, LLP
INTELLECTUAL PROPERTY GROUP

By _____
Glenn J. Perry
Reg. No.: 28,458
Tel. No.: (202) 861-3070
Fax No.: (202) 822-0944

GJP/JMC
1100 New York Avenue, N.W.
Washington, D.C. 20005-3918
(202) 861-3000